

Integrated Analysis.

Emmett, B. A.; Alison, J.; Braban, C.; Dickie, I.; Gunn, I. D. M.; Healey, J.; Jenkins, T.; Jones, L.; Keenleyside, C.B.; Lewis-Reddy, E.; Martineau, A.H.; Newell-Price, J. P.; Old, G.H.; Pagella, T.; Siriwardena, G.M.; Williams, A.P.; Williams, J.R.

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Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP) Sustainable Farming Scheme Evidence Review

Report 10a: Integrated Analysis

Emmett, B.A.¹, Alison, J.¹, Braban, C.¹, Dickie, I.², Gunn, I.D.M.¹, Healey, J.³, Jenkins, T.⁴, Jones, L.¹, Keenleyside, C.B.⁵, Lewis-Reddy, E.⁶, Martineau, A.H.⁷, Newell-Price, J.P.⁶, Old, G.H.¹, Pagella, T.³, Siriwardena, G.M.⁸, Williams, A.G.⁹, Williams, A.P.³ & Williams, J.R.⁶

¹ Centre for Ecology & Hydrology, ² eftec, ³ Bangor University, ⁴ Forest Research, ⁵ Institute for European Environmental Policy, ⁶ ADAS, ⁷ Ricardo, ⁸ British Trust for Ornithology, ⁹ Cranfield University

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CEH contact details Bronwen Williams
Centre for Ecology & Hydrology, Environment Centre Wales, Deiniol Road, Bangor, Gwynedd, LL57 2UW
t: 01248 374500
e: erammp@ceh.ac.uk

Corresponding Author Bridget Emmett, CEH

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Version	Updated By	Date	Changes
0.1	BE	31/5/2019	Initial draft as Annex 10
0.2	WG	18/6/2019	Responses from WG
0.3-1.0	BE	27/6/2019	Edit to WG comments (10a & 10b split)
1.1	PMO	8/7/2019	For publication

Contents

- 1 Introduction..... 2
- 2 Integrated Assessment Approach 4
 - 2.1 Summary table 5
 - 2.2 Selection of interventions to support.....25
 - 2.3 The importance of spatial configuration of interventions in a landscape26
 - 2.4 Metrics and verification and support for an adaptive approach26

1 Introduction

The Welsh Government commissioned a series of evidence reviews to support the development of proposals for future agricultural schemes. The reviews explored the evidence for interventions around a number of key areas, and their causal links to environmental, economic and social outcomes. As part of these reviews, the Welsh Government also requested an integrated analysis to bring the findings of the evidence reviews together:

“The objective of this task is to undertake an integrated analysis across all tasks to identify interdependencies, conflicts and synergies. In undertaking this task a vision of what a new Sustainable Farming Scheme could look like based on the findings should be included.”

At the request of Welsh Government this review was split into two parts due to the fundamental difference of the nature of the two elements embedded in the task outlined above.

The first part of the WG request was for an Integrated Analysis that required an objective synthesis of the other nine Evidence Reviews exploring the interactions and co-benefits of individual interventions and outcomes. The outcome of this task is presented here. As such, this document forms a summary of the key findings of the review. The technical detail of each review is contained in a series of technical annexes that can be accessed from the ERAMMP website (www.erammp.wales)¹.

The second part of the task provided an opportunity for the evidence review team to offer some suggestions as to the concept, design, operation and evaluation of the new scheme. A complete vision for the scheme was not possible within the time schedule of the project and it is unlikely a consensus could have been reached. Instead in Report 10b: *Considerations for the new scheme*, we provide a series of considerations we hope is of value to Welsh Government during their deliberations.

The topics for all ten reviews are shown in Table 1.1. Responsibility for leading each review was commissioned by CEH on behalf of the ERAMMP consortium from a range of organisations with a track record in the field. All organisations involved within the ERAMMP consortium were offered an opportunity to contribute to all of the reviews.

¹ <https://erammp.wales/en/resources>

Report/Annex Ref.	Title
1	Soil Nutrient Management (SNM)
2	Sward Management
3	Soil Carbon Management (SCM)
4	Building Ecosystem Resilience
5	Building Resilience in Farm Systems
6	Public and Private Funding
7	Systems Approach to GHG Emissions Reduction
8	Improving Air Quality and Well-being
9	Flood Mitigation
10a	Integrated Analysis (this document)
10b	Considerations for the new scheme

Table: 1.1 Index of Evidence Pack Review Reports and Technical Annexes

An initial workshop was convened to bring together Welsh Government leads for each review topic and members of the ERAMMP team who had indicated an interest in contributing to the reviews to ensure a good understanding of the scope of each review. Initial working drafts of each review were then developed prior to a second workshop where these drafts were subjected to internal challenge and further development. Review leads then took responsibility for consolidating these edits and comments to produce a final draft. Final review drafts were submitted to Welsh Government for comment before final edits were completed and the completed reviews submitted to Welsh Government on the 30th June 2019.

As part of the 2nd workshop, a structure for a table to enable an integrated analysis of the reviews was developed and agreed by the team. This table is intended to capture trade-offs and co-benefits between interventions and their outcomes. The team collectively completed the table and the final outcome is thus the result of all the participants of workshop 2. This co-production is reflected in the authorship list of this report.

2 Integrated Assessment Approach

Each individual review has considered the logic chain and causal links to outcomes for specific interventions or actions. Following this assessment, a set of issues were considered for each intervention to ensure the practicality, sustainability and potential trade-offs or co-benefits for each intervention were understood. These issues were:

- Evidence base: Causal link; Magnitude; Timescale
- Sustainability / resilience issues: Longevity/permanence; Climate interactions
- Co-benefits and trade-offs: Spatial issues; Displacement issues
- Operational issues: Social and economic barriers; Metrics and verification

A colour-coding system was then used to capture an overall assessment as to whether the team identified any major gaps in the evidence chain and/or whether there were significant trade-offs, co-benefits or leakage issues when matched against Welsh Government outcomes of interest. These outcomes are fully explained and defined in the consultation document *Sustainable Farming and Our Land*. The principal outcomes include: Air quality, Productivity (Reduced input costs), Public Health, GHG balance, Biodiversity and Water quality.

A colour-coding system was used to summarise the evidence base for each intervention. This was requested by WG to enhance the clarity of message. The colour coding is as follows:

- Blue = well tested at multiple sites with outcomes consistent with accepted logic chain. No reasonable dis-benefits or practical limitations relating to successful implementation.
- Amber = agreement in the expert community there is an intervention logic chain which can be supported, but either evidence is currently limited and/or there are some trade-offs or dis-benefits which WG need to consider.
- Pink = either expert judgement does not support logic chain or whilst logic chain would suggest it should work there is evidence of one or more of the following:
 - its practical potential is limited due to a range of issues (e.g. beyond reasonable expectation of advisory support which can be supplied and/or highly variable outcome beyond current understanding or ability to target),
 - the outcome / benefit is so small in magnitude with few co-benefits that it may not be worth the administration costs,
 - there are significant trade-offs.
- Grey = out of scope of the review task.
- White = not relevant to intervention or not considered due to time constraints.

Note that 'Amber' does not indicate the intervention is not supported by the expert reviewers. The amber coding reflects that, whilst the evidence base is limited and/or there are operational issues that need to be considered, the logic chain is consistent and the intervention could be worth supporting in the scheme. It is important to recognise that the practicality of collection of definitive evidence varies between

targets, systems and interventions, so there will always be more uncertainty in some areas than others, such as for ecological versus physical responses.

For clarity and due to space limitations the following terms have been used and are defined here:

- ‘Appropriate habitat management’
This is defined as the management that is required in order to maintain, to improve or to create a wide range of broadly semi-natural habitats that are found on farms and common grazings, which depend to a greater or lesser extent on land management activities of the farmer. The details of the required management therefore differ with habitat context. In Wales, these habitats include significant areas of marginal semi-natural grasslands which have been agriculturally semi-improved but retain their potential for habitat improvement.
- ‘Appropriate manufactured fertiliser application on improved land’
Application of manufactured fertiliser at the right time, in the right place and the right amount to meet crop requirements to achieve the economic optimum in arable or horticultural crop production and to grow the grass needed (within regulatory limits) to feed the animals on a livestock farm.

2.1 Summary table

The consolidated table for all interventions across all topics is presented as Table 2.1.1. In summary, 57 interventions were reviewed and captured in the table. However, many interventions appear several times, illustrating how individual interventions rarely affect only a single outcome and why an integrated approach is needed when exploring their potential.

Table 2.1.1 Summary table for all interventions reviewed (Sustainable Farming Scheme: ERAMMP Evidence Pack Review). This table contains a summary of the evidence base of potential outcomes from a range of interventions that have been reviewed by the ERAMMP SFS Evidence Review team. Note that some interventions have been considered in several reviews. The colour coding for each outcome for each intervention indicates the status of the evidence base for the specific outcome when this has been considered. The colour code of the overall 'Topic & Intervention' cell reflects the final recommendation by the team after considering the impact of the intervention across a range of environmental, economic and social outcomes of interest to Welsh Government (i.e. Productivity, Air Quality, Public Health, Water Quality, GHG balance and Biodiversity). Note that the Outcomes have been further broken down into more precise categories for the purposes of the review and greater clarity. Note also that it was only possible to consider the outcome of Public Health within the Air Quality review but that this does not reflect the limit of potential Public Health outcomes from these interventions. These outcome categories are reflective of the overall definitions contained in the consultation document *Sustainable Farming and Our Land*.

Colour Key:

- **Blue** = well tested at multiple sites with outcomes consistent with accepted logic chain. No reasonable dis-benefits or practical limitations relating to successful implementation.
- **Amber** = agreement in the expert community there is an intervention logic chain which can be supported but either evidence is currently limited and/or there are some trade-offs or dis-benefits which WG need to consider.
- **Pink** = either expert judgement does not support logic chain and/or whilst logic chain would suggest it should work there is evidence of one or more of the following:
 - its practical potential is limited due to a range of issues (e.g. beyond reasonable expectation of advisory support which can be supplied and/or highly variable outcome beyond current understanding or ability to target),
 - the outcome/benefit is so small in magnitude with few co-benefits that it may not be worth the administration costs,
 - there are significant trade-offs.
- **Grey** = out of scope of the review task.
- **White** = not relevant to intervention or not considered due to time constraints.

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition	Improve condition of semi-natural habitat	
												Biomass	Soil				
	Review 1: Soil Nutrient Management																
1	Implementation of nutrient management plans on improved grassland and arable land	Manufactured fertiliser; Manure and organic inputs; Grazing; Vegetation management (mixed); Benchmarking, baseline and skills.	Only where baseline is below economic optimum		Magnitude depends on the baseline	Magnitude depends on the baseline		Magnitude depends on the baseline	Reduced NH ₃ emissions	Assuming integration of manure and fertiliser nutrient supply	Assuming integration of manure and fertiliser nutrient supply		Only where baseline is below economic optimum See Review 3.	Where nutrient management adjusted to optimise plant species composition			Must be catchment scale to have meaningful impact on water quality
	Review 2: Sward Management																
2	Diversification of swards in improved grassland	Vegetation management (mixed)	Some evidence Not in Welsh conditions	Needs to be tried & tested	Reduced nitrate	Reduced N load	Lack of evidence	Limited to where manufactured N fertiliser is reduced		Limited to where manufactured N fertiliser is reduced	Mainly due to reduced manufactured N fertiliser use		See Review 3	Plant, pollinator and other animal diversity			Biodiversity / Water Effect due to proximity/ increasing connectivity of Semi-Natural patches

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach
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												Biomass	Soil				
	Review 3: Soil Carbon Management (SCM)																
	SCM - Improved Grass (as defined by author of study)																
3	Appropriate grazing	Grazing	'Blue' if stocking maintained, rotations improved, over-grazing reduced	'Blue' if stocking maintained, rotations improved, over-grazing reduced			See Review 9						For example, positive effects if over-grazing reduced in the process				
4	Appropriate cutting	Cutting					See Review 9										
5	Sward Management	Vegetation management (mixed)			Reduced nitrate					Limited to where manufactured N fertiliser is reduced			Evidence for deep rooted grasses and N fixers				
6	Manure application ('Blue' if included in nutrient management)	Manures and organic inputs			See Review 1			See Review 8		Displaces manufactured fertiliser							

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7	Liming	Manufactured fertiliser and liming	Increased productivity only if pH too low		Potential benefit for offsetting acidified waters					Potentially by reducing manufactured fertiliser but GHG from lime production							
8	Prevent <i>permanent</i> grassland conversion to arable**	Conversion	See Review 10b for more in-depth analysis		Reduces risk to water as more permanent veg cover		See Review 9							At the field scale, grassland fields support higher biodiversity			Heterogeneity in the landscape such as small areas of arable can be positive and vice versa. This is landscape-context-dependent
9	Afforestation / Agroforestry	Trees and shrubs inc. agroforestry	Could lead to displacement. May balance out for agroforestry, depending on details.		Can be benefits but also risks e.g. of erosion due to management operations		See Review 9	See Review 8	See Review 8	See review 7			Evidence needed	Increase field-scale biodiversity			Effect due to proximity / increasing connectivity of Semi-Natural patches, especially with appropriate tree species

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												Biomass	Soil				
10	Increasing manufactured fertiliser	Manufactured fertiliser and liming	Potential for increase if N limited production		Potential risk for waters			See Review 8	See Review 8	Displacement into fertiliser production							Risk of fertiliser movement into waters affected by location
SCM – Cropland																	
11	Cover cropping	Soil protection	Mixed evidence on the yield of the following crop		Reduces risk of sediment run-off as less bare soil		See Review 9			N ₂ O emissions when ploughed back in during intensive operations; less N fertiliser use				Potential bird habitat but reduces habitat quality for some species			
12	Tillage reduction	Soil protection			Fine sediment run off will reduce		See Review 9							Good for earth-worms			
13	Grass leys/convert to grassland/herbal leys	Conversion					See Review 9							Probable field-scale biodiversity benefits			

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												Biomass	Soil				
14	Afforestation/ agroforestry (positive enough for buffer strips etc., some agroforestry)	Trees and shrubs inc. agroforestry	Reduces area available for food production. / potential for displacement	More mixed system could increase resilience	Could help reduce runoff if well placed		See Review 9	See Review 8	See Review 8				Evidence needed	Increase field-scale biodiversity			Effect due to proximity/ increasing connectivity of Semi-Natural patches, especially with appropriate tree species
15	Organic inputs	Manures and organic inputs			See Review 1			See Review 8	See Review 8	See Review 1				Positive for soil invertebrates and other taxa, if at appropriate levels			
16	Increasing manufactured fertiliser	Manufactured fertiliser and liming	Potential for increase if N limited		Potential risk for fresh waters			See Review 8	See Review 8	Displacement into fertiliser production							Risk of fertiliser movement into waters affected by location

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	SCM – Uplands																
17	Prevent drainage, restore peatlands	Peats, wetlands and floodplains					See Review 9										Scaling benefits likely for biodiversity and water quality
18	Prevent improvement, reduce grazing	Conversion / grazing					See Review 9						Some evidence that improvement and heavy grazing reduce SOC		Depends on current grazing regime; site- and habitat-specific	Depends on current grazing regime; site- and habitat-specific	
19	Burning/cutting management	Burning / cutting			Potential risks		See Review 9	Burning contributes to particulate emissions PM2.5s	Health risks linked to PM2.5s				Lack of evidence		Depends on current regime; site- and habitat-specific	Depends on current regime; site- and habitat-specific	Scale and proximity to urban centre needs to be considered with respect to health impacts

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20	Afforestation	Trees and shrubs inc. agroforestry	Could lead to displacement		Could be benefits but also risks depending on management (e.g. erosion during felling) and soil type (e.g. some soils could lead to acidification of waters).		See Review 9	See Review 8	See Review 8	See Review 7				Potentially beneficial on improved grassland, if using native tree species	Conversion of existing semi-natural habitat to a new one	Conversion of existing semi-natural habitat to a new one	Positive for other woodland, negative for open habitats; also potential benefits from landscape heterogeneity
	Review 4: Building ecosystem resilience																
	Semi-natural habitat management of unimproved (including semi-improved) pastures and hay-meadows																
21	Grazing within broad annual stocking density thresholds (lower and upper thresholds encompassing the range of situations appropriate for semi-natural habitats).	Grazing					See Review 9						See Review 3				

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach
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22	Maintaining and improving the condition of existing habitats, (including semi-improved grasslands)	Vegetation management (mixed)					See Review 9						See Review 3				Important for common land to consider landscape issues
23	More detailed grazing interventions applicable to specific semi-natural habitats or mosaics of habitats, including variations in: a. Seasonal stocking thresholds; b. Temporal and spatial grazing patterns within the holding, including temporary/seasonal exclusion in particular areas c. Grazing livestock species and breeds, and combinations of species	Grazing					See Review 9						See Review 3				

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24	Management interventions generally applicable on semi-natural habitats to complement and/or facilitate appropriate grazing d. Temporally and spatially appropriate cutting and removal of vegetation such as scrub, bracken, rushes, etc. e. Improvement of fencing, gates, water points to facilitate appropriate grazing management.	Vegetation management (mixed)					See Review 9						See Review 3				

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25	Management interventions specific to certain habitat types: a. Mowing and harvesting (hay meadows) b. Habitat appropriate fertilisation / liming (hay meadows) c. Blocking of drains and grips (blanket bog, wet grasslands) f. Re-establishment of appropriate native species on semi-improved land	Cutting / Manufactured fertiliser and liming / peats, wetland and floodplains					See Review 9 for blocking of grips and drains						See Review 3				
26	Burning where appropriate (heather moorland)	Burning					See Review 9	Burning results in emissions of particulates PM2.5s	Health impact of particulates PM2.5s.				See Review 3			Very scale-dependent	Best practice is to create a mosaic. Scale and proximity to urban centres need to be considered

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	Farm Woodland habitat management																
27	Retain and improve diversity within woodlands of: • species by planting/natural regeneration of UK native species, including understorey species where appropriate; this would include PAWS • tree species genotypes, especially for long-term resilience to climate threats (pests, diseases, drought) • age structure and silvicultural system (incl. continuous cover, LISS, and long-term retention) • diversity of open habitats, wet habitats within the woodland • retention of deadwood	Vegetation management (mixed)					See Review 9						See Review 3				

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance			Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
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28	Control measures (fencing, limited grazing where appropriate) for livestock and deer	Livestock exclusion											See Review 3				
29	Improve connectivity of native woodland patches by allowing natural regeneration of native species (only) or planting	Trees and shrubs inc. agroforestry		Biosecurity issues include; Positives including separation of livestock: Negative potential for conduit for disease			See Review 9	See Review 8	See Review 8				See Review 3		Depends on the effective-ness of improve-ments to connec-tivity	Depends on the effective-ness of improve-ments to connec-tivity	Need to consider biosecurity issues / disease transfer – strategic decision
30	Use of tree species tolerant of future climate advised from modelling for creation and connectivity and under-represented native trees species	Trees and shrubs inc. agroforestry													Evidence tree species are moving north		

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												Biomass	Soil				
31	Control measures aimed at INNS, pests and diseases (covers a huge number of detailed interventions that are positive if effective but efficacy has not always been proven)	Other													Big mix of interventions	Big mix of interventions	There are practical and economic issues when scaling up; should remove sources of inoculum
Trees and shrubs in farmland (inc. Agroforestry)																	
32	Habitat-appropriate management of existing: <ul style="list-style-type: none">• scrub habitats• parkland (including veteran trees• hedgerows/ cloddiau,• trees in hedges, in field boundaries, in fields, in ffridd• old orchards	Trees and shrubs inc. agroforestry					See Review 9						See Review 3				The ffridd has important mosaic landscape considerations

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition	Improve condition of semi-natural habitat		
												Biomass	Soil					
33	Creation of new agroforestry on arable/improved grassland	Trees and shrubs inc. agroforestry	Could lead to displacement. May balance out for agroforestry, depending on details.					See Review 9	See Review 8	See Review 8	See Review 3 and 7	See Review 3 and 7		See Review 3 and 7				Potential benefits from specific agroforestry
34	Restoration of silvopastoral systems on appropriate semi-natural habitats	Trees and shrubs inc. agroforestry						See Review 9	See Review 8	See Review 8	See Review 3 and 7	See Review 3 and 7		See Review 3 and 7		Shifts in species likely to result	Shifts in species likely to result	
35	Ensure eligibility of land with trees and other woody plants for SFS (compared to current CAP rules, which restrict eligibility of some farmland with trees and shrubs of biodiversity vale)	Benchmarking, baseline and skills														Evidence that CAP rules don't work and degradation of ineligible land/ woody features	Evidence that CAP rules don't work and degradation of ineligible land/ woody features	Evidence that CAP rules don't work and degradation of ineligible land/ woody features
All habitat interventions																		
36	Skills interventions: <ul style="list-style-type: none">assessorsfarmers	Benchmarking, baseline and skills																Farmer facilitation fund work in progress

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition	Improve condition of semi-natural habitat	
												Biomass	Soil				
37	Introduce pilot result-based payment schemes for key farmland habitat types	Benchmarking, baseline and skills													Research currently in progress	Research currently in progress	
Review 7: Systems approach to GHG reduction																	
38	Assessment of GHG emissions at a farm scale	Benchmarking, baseline and skills	Emissions intensity improvements increasing productivity		Depending on the mitigation measures			Measure specific		Tool for the identification of measures			See Review 3				
39	Recording Farm Scale sequestration for woody biomass	Benchmarking, baseline and skills											See Review 3				
40	Recording of Farm Scale Carbon Sequestration from Grass	Benchmarking, baseline and skills											Large variation and uncertainty				
41	Additional Farmer administration	Benchmarking, baseline and skills								Likely requirement guidance							
42	Aggregation of data to provide Industry Indicator	Benchmarking, baseline and skills	Better targeting of activities							Benefits in understanding farm-scale emissions							

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition	Improve condition of semi-natural habitat	
												Biomass	Soil				
	Review 8: Improving Air quality and well-being																
43	Reduction of manure at source; Improved manure storage; Improved manure spreading. (Fertiliser application covered under 'Soil nutrient management')	Manures and organic input	Some potential for reduced productivity, but mostly neutral		Magnitude depends on measure			Magnitude depends on measure. Some (e.g. manure spreading) may not be effective in reality)	Reduced NH3 emissions	See Review 1 and 7 Mixed. Some small potential to increase N2O, or CH4 emissions (e.g. manure storage)	See Review 1 and 7		See Review 3		Targeting emissions management, and woodland capture can maintain pristine habitats in good functioning condition		Benefits multiply at scale. Keeping clean areas pristine benefits biodiversity
44	Land Use Change (Conversion from intensive to semi-natural or extensive)	Conversion	Reduced productivity / displacement				See Review 9		Reduced NH ₃ emissions		See Review 7		See Review 3				Benefits multiply at scale
45	Woodland planting near to point sources, as buffers adjacent to protected areas, and in wider landscape	Trees, shrubs incl. agroforestry	Some loss of productive land		Mixed. Some potential to intercept nutrients, but potential for pollution swapping		See Review 9	Reduced concentrations	Reduces concentrations of PM, NH3 and other pollutants. Magnitude varies.	See Review 7	See Review 7		See Review 3		Context dependent	Context dependent	Benefits multiply at scale. Targeting planting locations can maximise health benefits

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition	Improve condition of semi-natural habitat	
												Biomass	Soil				
	Review 9: Flood Mitigation																
46	Floodplain and wetland restoration	Geomorphological and structural	Flooding reduces productivity					See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				
47	Floodplain woodland	Trees, shrubs incl. agroforestry ; Peats, wetlands and floodplains	Timber production					See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				
48	Leaky barriers	Geomorphological and structural	Flooding of riparian areas reduces productivity							See Review 7	See Review 7		See Review 3				
49	Offline storage areas	Other (Geomorphological)	Reduces productivity when filled with flood water							See Review 7	See Review 7		See Review 3				
50	Catchment woodland	Trees, shrubs incl. agroforestry	Timber production					See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				
51	Cross-slope woodland	Trees, shrubs incl. agroforestry	Timber production					See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance				Functioning Habitats			Major added value of a landscape / proximity / catchment approach
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition	Improve condition of semi-natural habitat	
												Biomass	Soil				
52	Riparian woodland	Trees, shrubs incl. agroforestry; Peats, wetlands and floodplains						See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				
53	Run-off pathway management	Geomorphological and structural															
54	Headwater drainage management	Peats, wetlands and floodplains											Peat conservation		Functioning peatland	Functioning peatland	
55	Soil and land management (arable)	Vegetation management (mixed)	Increase with soil condition	Increase with soil carbon						See Review 7	See Review 7		See Review 3				
56	Soil and land management (grassland)	Vegetation management (mixed)								See Review 7	See Review 7		See Review 3				
57	Woody landscape features	Vegetation management (mixed)	Pollination benefits	Pollination benefits				See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				

Table 2.1.2 identifies where interventions of a similar management type have been separately considered in different reviews. The many amber codings illustrate the many trade-offs and co-benefits of different interventions. The different colour coding for similar interventions also illustrates that the intended target and context of how the intervention is implemented is critical.

Table 2.1.2 The 57 interventions which have been reviewed, classified by 14 management types and the final colour coding.

Management type	Review No.	Intervention number	Blue	Amber	Pink
Manufactured fertiliser and liming	1, 3, 4	1,7,10,16,25	2	1	2
Grazing	3, 4	3,18,21,23	2	2	
Manures and organic inputs	3, 8	6,15,43	3		
Vegetation management (mixed)	2, 3, 4	2,5,11,21,22	4	1	
Trees and shrubs incl. agroforestry and wet woodlands	3, 4, 8, 9	9,20,27,29,33,34, 45,47,50,51,52,57	2	10	
Conversion (not involving woody vegn)	3, 8	8,13,18,44	3	1	
Soil protection	3, 4, 9	11,22,55,56	1	3	
Peats, wetlands and floodplains	3, 4, 9	17,25,46,47	2	2	
Burning	3, 4	19,26		2	
Cutting	3, 4	4,19,24,25	2	2	
Livestock exclusion	4	24,28	2		
Invasives, non-native species and pests and disease				1	
Geomorphological and structural	9	46,48,49,53		4	
Benchmarking, Baseline and skills	1, 4, 7	1,35,36,37,38,39,40,41,42	6	3	

2.2 Selection of interventions to support

Clearly the final list of interventions to be supported will be dependent on policy priorities and cost-benefit assessments. Most interventions examined were worthy of consideration with some clear 'Blue' interventions within all 14 management categories.

However, the team are keen to point out ‘Amber’ does not indicate the intervention is not supported by the expert reviewers. Rather it is our attempt to be transparent and promote an adaptive approach to keep ahead of increasing challenges in a post Brexit world combined with increasing challenges related to climate change. The amber coding reflects that, whilst the evidence base is limited and/or there are operational issues that need to be considered, the logic chain is consistent and the intervention could be worth supporting in the scheme if displacement and other potential risks are taken on board. In all cases and for all interventions being considered, we would encourage the specific review is read in depth rather than relying on the summary table.

Increasing uses of manufactured fertiliser were the only interventions that received a ‘Pink’ coding. The evidence base, including the greenhouse gas emissions associated with the manufacture of fertiliser and increased risks to water quality, outweigh the potential benefits.

2.3 The importance of spatial configuration of interventions in a landscape

An important spatial contextual element was highlighted for many interventions. This often related to important added value that could be achieved, or indeed the necessity for a benefit to be realised, from the spatial configuration of the intervention in the landscape. This spatial element tends to be strongest in the water quality, flood mitigation, air quality and biodiversity interventions. Benefits could be related to interventions being close to point sources of pollution or to the synergistic effects of applying the interventions in adjacent farms within a catchment or landscape. It should be noted, however, that there may also be unanticipated negative effects if some variation is not maintained in the landscape. For example, there is a risk of synchronising flood waves from sub-catchments, by reducing variability in catchments, and also of providing unintended corridors and connectivity for disease and invasive and non-native species by universal application of ‘better connectivity’ principles. Nevertheless, developing elements of the scheme to capture the benefits of contiguous application of interventions within a catchment could be beneficial.

2.4 Metrics and verification and support for an adaptive approach

Overall, the team supports an adaptive / flexible approach to ensure suitable changes can be made as new evidence emerges from research and ongoing monitoring and evaluation. No review is ever complete and the time limit for these reviews was particularly challenging. In particular, we would encourage a sharing of this evidence base with other countries currently reviewing the evidence base (e.g. Natural England for Defra) to compare and to challenge our findings.

It should also be noted that the nine reviews contain many suggestions and issues relating to metrics and verification issues that are not summarised here.

Adaptation of the new scheme as new evidence emerges or as new priorities are set could include:

- Improved targeting

Arising, for example, from (a) unexpected new farming practices in an area, (b) new evidence of point sources of pollution that would yield greater impact if controlled or (c) evidence of ecological thresholds and their location that could yield greater benefits if targeted.

- Change in payment rates for interventions

Arising from change in costs associated with an intervention and/or improved evidence base of a lower or higher impact / return for investment in an intervention over time.

- Change in the specifics of an intervention / management practice

Arising from new evidence, such as feedback from monitoring of intervention effects, of the specific practical operational requirements for an intervention to reduce trade-offs or to improve the magnitude or permanence of the intended outcome.

- Introduction or removal of an intervention

Arising, for example, from (a) fundamental changes in the causal evidence chain (e.g. new research evidence), (b) shifts in the socio-economic environment that make an intervention change its current status, or (c) emergence of a new approach not previously considered.

Enquiries to:
ERAMMP Project Office
CEH Bangor
Environment Centre Wales
Deiniol Road
Bangor
Gwynedd
LL57 2UW
T: + 44 (0)1248 374528
E: erammp@ceh.ac.uk

www.erammp.cymru

www.erammp.wales